Rice University
Civil and Environmental Engineering

CEVE 420/520 – ENVIRONMENTAL REMEDIATION AND RESTORATION

SPRING 2021 Syllabus

Course objective

The objective of this class is to provide you with the knowledge of the processes, chemicals, technologies, and institutional considerations that you need to select an appropriate method for cleaning up contaminated soil, groundwater, sediment, and surface water that has become adversely impacted by chemicals.

Textbooks

Practical Design Calculations for Groundwater and Soil Remediation, Second Edition by Jeff Kuo, CRC Press; June 2, 2014, ISBN-10: 1466585234.

I will also give you technical papers, other book extracts, and reading assignments from time to time. We will make extensive use of internet resources. I will include the relevant internet links in the lecture notes. Lecture slides will usually be distributed before each lecture. Lectures, lecture recordings, and problem solutions will be posted to Canvas.

Grading

Exams (2)	50%
Homework	25%
Final design project	25%

Exams

Two closed-book exams will be given in class. The first exam is tentatively scheduled for March 4, and the second is tentatively scheduled for April 6. Both exams will be mostly qualitative with short answers to test your knowledge of specific issues and your understanding of key concepts. There will also be some brief quantitative exam questions to make sure that you know how to apply some of the principles taught.

The final will be a quantitative problem similar to the homework assignments that involves the design of a groundwater capture system and water treatment system.

Homework

Homework assignments will generally be due 1 to 2 weeks after distribution. Assignments and solutions will be posted on Canvas. Grades on late homework assignments will be reduced by 10 percent of the possible homework grade for each day or part of day that they are late. Homeworks focus on quantitative calculations typical of remediation projects. Extensions can be given *with prior arrangement*.

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Final Design Project

For the final design project, you will review and analyze data from real site investigation and feasibility study reports. You will then perform quantitative calculations to support the design of two elements of a groundwater remediation system: a groundwater capture system and a water treatment system.

Field trip to Industrial Site

Conditions permitting, we will take a field trip to an industrial site to see monitoring wells and see active groundwater extraction systems. The trip is tentatively scheduled for April 1, but it could be moved earlier or later depending on the weather and class activities.

Instructor and Office Hours

Phillip C. de Blanc, Ph.D., P.E.
Lecturer in Civil and Environmental Engineering
107 Mech Lab
Phone: 713-348-4725
Mobile: 281-635-6069 (Emergencies only please!)
Email: pcdeblanc@rice.edu

Office hours 3:15 to 4:15 Thursdays.

I check email regularly, and you are encouraged to communicate by email whenever possible. I will usually respond within a few hours, but never more than 24 hours later (except on weekends and holidays).

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1. Introduction - Why clean up the environment?
2. Overview of environmental contamination
    a. Sources and Extent of Chemical Contamination in the U.S. and World
    b. Types of sites
    c. Types of Media Affected with examples
    d. Classes of chemical contaminants
    e. Physical nature of contaminants (dissolved, NAPLs, etc.)
3. Site Investigation
    a. Objectives – ID nature, magnitude, and extent of impacts
    b. Conceptual model
    c. Preliminary assessment
    d. Field investigation techniques
    e. Field testing techniques (slug tests, pumping tests, tracer tests)
    f. Laboratory analyses
    g. Assessing extent of impacted media (interpolation techniques, etc.)
4. Risk Assessment
    a. Fundamentals – dose, pathways
    b. Carcinogenic and non-carcinogenic risk considerations
    c. Forward calculations – determining risk from a site.
    d. Backward calculations – calculating cleanup levels
    e. Statistical methods for cleanup
5. Chemical and Physical Properties Affecting Remediation Technologies
    a. Media Characteristics
    b. Chemical Characteristics
    c. Institutional
6. Remediation objectives and classification of technologies
    a. Remediation Objectives
    b. Classification of Remediation Technologies
7. Technologies for Soil Remediation
8. Technologies for Groundwater Remediation
    a. Groundwater extraction
    b. Ex-situ groundwater treatment
    c. In-situ groundwater treatment
    d. Containment
9. Selection of remedial alternatives
    a. Sources of information on remediation technologies
    b. Factors to consider
    c. Presumptive remedies
    d. Technology evaluation
    e. Assembling technologies into complete alternatives
    f. Criteria for evaluation of alternatives
10. Remediation Design Elements
    a. Treatability testing
    b. Supplementary investigations
    c. Design
    d. Use of models
    e. Cost Optimization
    f. Long-term monitoring/sustainability

11. River and Sediment Remediation and Restoration
    a. Surface water
    b. Sediments
    c. Case studies

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Day	Date	Week	Class	Subject
Tue	26-Jan	1	1	First Day of Class Introduction
Thu	28-Jan	1	2	Contaminants/Site Investigations
Tue	2-Feb	2	3	Risk Assessment
Thu	4-Feb	2	4	Focus: Risk Assessment Guest Lecture - Tom McHugh
Tue	9-Feb	3	5	Chemical, Physical Properties
Thu	11-Feb	3	6	Soil remediation
Tue	16-Feb	4	7	Classes of remediation technologies
Thu	18-Feb	4	8	Soil remediation technologies
Tue	23-Feb	5	9	Soil remediation technologies
Thu	25-Feb	5	10	Soil remediation technologies
Tue	2-Mar	6	11	Focus: soil vapor extraction Guest Lecture: Travis McGuire
Thu	***4-Mar***	***6***	***12***	***Exam No. 1***
Tue	9-Mar	7	13	Groundwater remediation
Thu	11-Mar	7	14	Groundwater remediation technologies
Tue	***16-Mar***	***8***		***Spring Sprinkle Day - No Class***
Thu	18-Mar	8	15	Groundwater remediation technologies
Tue	23-Mar	9	16	Groundwater remediation technologies

Day	Date	Week	Class	Subject
Thu	25-Mar	9	17	Focus: engineered bioremediation Guest Lecture – Chuck Newell
Tue	30-Mar	10	18	Selection of remedial technologies
Thu	***1-Apr***	***10***	***19***	***Field trip***
Tue	***6-Apr***	***11***	***20***	***Exam No. 2***
Thu	***8-Apr***	***11***		***Spring Sprinkle Day - No Class***
Tue	13-Apr	12	21	Remediation design elements
Thu	15-Apr	12	22	Surface Water/Sediments
Tue	20-Apr	13	23	Focus: Sediment Remediation Guest Lecture: TBD
Thu	22-Apr	13	24	River restoration
Tue	27-Apr	14	25	Low impact development
Thu	29-Apr	14	26	Last day of class
Sat	1-May			Study days begin
Tue	4-May			Study days end
Wed	5-May			First day of finals
Wed	12-May			Last day of finals
Fri	14-May			Grades due